Contents

Acknowledgments vi A Note to the Student ix PART DC CIRCUITS	Preface	V		3.7 Nodal Versus Mesh Analysis 99
A Note to the Student ix PART DC CIRCUITS	Acknowled	dements vi		
PART DC CIRCUITS				† 3.9 Applications: DC Transistor Circuits 102
Chapter Basic Concepts 3	A Note to	the Student 1x		· · · · · · · · · · · · · · · · · · ·
Chapter Sair Concepts 3	PART I DC	CIRCUITS		Problems 109
1.2 Systems of Units 4 1.3 Charge and Current 6 1.4 Voltage 9 1.5 Power and Energy 10 1.6 Circuit Elements 13 1.7 Applications 15 1.7.1 TV Picture Tube 1.7.2 Electricity Bills	Ch	apter I Basic Concepts 3		Comprehensive Problems 117
1.1 Systems of Units 4 1.3 Charge and Current 6 1.4 Voltage 9 1.5 Power and Energy 10 1.6 Circuit Elements 13 1.7 Applications 15 1.7.1 TV Picture Tube 1.7.2 Electricity Bills 1.8 Problem Solving 18 1.9 Summary 21 Review Questions 22 Problems 23 Comprehensive Problems 25 2.1 Introduction 28 2.2 Ohm's Laws 28 2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 2.7 Wye-Delta Transformations 50	1.1	Introduction 4		Chapter 4 Circuit Theorems 119
1.3 Charge and Current 6 1.4 Voltage 9 1.5 Power and Energy 10 1.6 Circuit Elements 13 1.7 Applications 15 1.7.1 TV Picture Tube 1.7.2 Electricity Bills 1.8 Problem Solving 18 1.9 Summary 21 Review Questions 22 Problems 23 Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 42 2.6 Parallel Resistors and Voltage Division 42 2.7 Wye-Delta Transformations 50 2.8 Lighting Systems 2.8.2 2.9 Summary 60 2.8.1 Lighting Systems 2.8.2 2.9 Summary 60 2.8 Design of DC Meters 2.8 2.9 Summary 60 2.8 Lighting Systems 72 2.9 Summary 60 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 76 3.3 Nodal Analysis 76 3.3 Nodal Analysis 76 3.3 Nodal Analysis 87 3.5 Mesh Analysis 87 3.5 Mesh Analysis 87 3.5 Mesh Analysis with Voltage Sources 92 4.4 Source Transformation 127 4.4 Source Transformation 127 4.5 Norton's Theorem 137 4.6 Norton's Theorem 137 4.7 Derivations of Thevenin's and Norton's Theorems 140 4.8 Maximum Power Transfer 142 4.9 Verifying Circuit Theorems with <i>PSpice</i> 144 4.10 Applications 147 4.10 Applications 153 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 154 Comprehensive Problems 162 Chapter 5 Operational Amplifiers 166 5.1 Introduction 166 5.2 Operational Amplifier 171 5.3 Nonlinverting Amplifier 174 5.4 Enverin's Theorem 137 4.5 Norton's Theorem 137 4.6 Norton's Theorems 140 4.8 Maximum Power Transfer 142 4.9 Verifying Circuit Theorems with <i>PSpice</i> 144 4.10 Applications 153 7.10 Operational Amplifiers 166 5.2 Operational Amplifier 171 5.5 Nonlinverting Amplifier 177 5.6 Summary 188 5.10 Application	1.2	Systems of Units 4		
1.4 Voltage 9 1.5 Power and Energy 10 1.6 Circuit Elements 13 1.7 Applications 15 1.7.1 TV Picture Tube 1.7.2 Electricity Bills 1.9 Summary 21 21 1.9 Summary 21 22 24 Source Transformation 127 2.5 Electricity Bills 1.9 Summary 21 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 2.8 Lighting Systems 2.8 2.8 Design of DC Meters 2.8 Lighting Systems 2.8 2.8 Design of DC Meters 2.9 Summary 60 60 60 60 60 60 60 6	1.3	Charge and Current 6		
1.5 Power and Energy 10	1.4	Voltage 9		3 1 3
1.1.	1.5	Power and Energy 10		
1.7.1 TV Picture Tube 1.7.2 Electricity Bills 1.7.2	1.6	Circuit Elements 13		
1.7.1 TV Picture Tube 1.7.2 Electricity Bills 1.8 Problem Solving 18 1.9 Summary 21 Review Questions 22 Problems 23 Comprehensive Problems 25 Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 2.2 Ohm's Laws 35 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Voltage Division 42 2.7 Wye-Delta Transformations 50 12.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 2.9 Summary 60 Review Questions 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 87 3.4 Mesh Analysis with Voltage Sources 82 3.5 Mesh Analysis with Voltage Sources 82 3.6 Mesh Analysis with Voltage Sources 82 3.7 Mesh Analysis with Voltage Sources 82 3.8 Mesh Analysis with Voltage Sources 82 3.9 Mesh Analysis with Voltage Sources 82 3.1 Mesh Analysis with Voltage Sources 82 3.1 Mesh Analysis with Voltage Sources 82 3.1 Mesh Analysis with Voltage Sources 82 3.2 Mesh Analysis with Voltage Sources 82 3.3 Mesh Analysis with Voltage Sources 82 3.4 Mesh Analysis with Voltage Sources 82 3.5 Mesh Analysis with Voltage Sources 82 3.6 Maximum Power Transfer 142 4.9 Verifying Circuit Theorems with PSpice 144 4.10.1 Source Modeling 4.10.2. Resistance Measurement 4.10.2. Re	†1 .7	Applications 15		
1.7.2 Electricity Bills 1.8 Problem Solving 18 1.9 Summary 21 Review Questions 22 Problems 23 Comprehensive Problems 25 Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 1.2 Ohm's Laws 28 1.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 76 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 87 3.4 Mesh Analysis with Voltage Sources 82 3.4 Mesh Analysis with Voltage Sources 82 3.5 Mesh Analysis with Voltage Sources 82 3.6 Mesh Analysis with Voltage Sources 82 3.7 Mesh Analysis with Voltage Sources 82 3.8 Review Questions 147 4.10 Applications 147 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.10.2 Resistance Measurement 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.10.		1.7.1 TV Picture Tube		
Review Questions 22 Problems 23 Comprehensive Problems 25 Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Voltage Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 76 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 87 Mesh Analysis with Current Sources 82 3.4 Mesh Analysis with Current Sources 82 3.5 Mesh Analysis with Current Sources 92 4.9 Verifying Circuit Theorems with PSpice 144 †4.10 Applications 147 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.10.2 Resistance Measurement 4.10.2 Resistance Measurement 4.10.2 Nource Modeling 4.10.2 Resistance Measurement 4.10.2 Nource Modeling 4.10.2 Resistance Measurement 4.10.1 Source Modeling 4.10.2 Comprehensive Problems 153 Problems 154 Comprehensive Problems 154 Comprehensive Problems 162 5.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuit Analysis with Voltage Sources 5.10.1 Digital-to Analog		1.7.2 Electricity Bills		
Review Questions 23 Comprehensive Problems 25 Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis with Current Sources 92 With PSpice 144 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 4.11 Summary 153 Review Questions 153 Problems 164 Comprehensive Problems 162 5.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 177 5.5 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190		_		4.8 Maximum Power Transfer 142
Problems 23 Comprehensive Problems 25 Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 87 Mill Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 Chapter 5 Operational Amplifiers 166 5.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 147 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 162 Chapter 5 Operational Amplifiers 166 5.1 Introduction 166 5.2 Operational Amplifiers 171 5.5 Noninverting Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 147 4.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 5.1 Introduction 166 5.2 Operational Amplifiers 174 5.5 Summing Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.10.2 Instrumentation Amplifiers 5.10.1 Summary 188 Review Questions 190	1.9	Summary 21		4.9 Verifying Circuit Theorems
Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis with Voltage Sources 82 3.5 Mesh Analysis with Current Sources 92 Review Questions 153 Problems 154 Comprehensive Problems 162 Chapter 5 Operational Amplifiers 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 147 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 5.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 177 5.8 Cascaded Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 147 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 5.1 Introduction 166 5.2 Operational Amplifiers 165 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 175 5.8 Cascaded Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.2 Instrumentation Amplifiers 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188	-			with <i>PSpice</i> 144
Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 76 3.3 Nodal Analysis 87 Mesh Analysis 87 Mesh Cascaded Qp Amp 170 4.10.1 Source Modeling 4.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 5.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 177 5.8 Cascaded Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190				† 4.10 Applications 147
Chapter 2 Basic Laws 27 2.1 Introduction 28 2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 76 3.3 Nodal Analysis 87 Mesh Analysis 87 A.10.2 Resistance Measurement 4.11 Summary 153 Review Questions 153 Problems 154 Comprehensive Problems 162 Chapter 5 Operational Amplifiers 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 177 5.8 Cascaded Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 153 Problems 154 Comprehensive Problems 162				4.10.1 Source Modeling
2.2 Ohm's Laws 28 †2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 87 3.4 Mesh Analysis 87 3.5 Mesh Analysis 87 Mesh Analysis with Current Sources 92 Review Questions 153 Problems 154 Comprehensive Problems 162 Chapter 5 Operational Amplifiers 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	Ch	napter 2 Basic Laws 27		· · · · · · · · · · · · · · · · · · ·
†2.3 Nodes, Branches, and Loops 33 2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis with Voltage Sources 82 3.5 Mesh Analysis with Current Sources 92 Problems 154 Comprehensive Problems 162 Chapter 5 Operational Amplifiers 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	2.1	Introduction 28		4.11 Summary 153
Comprehensive Problems 162 Chapter 5 Operational Amplifiers 165 Solution 166 Solution 171 Soluti	2.2	Ohm's Laws 28		
2.4 Kirchhoff's Laws 35 2.5 Series Resistors and Voltage Division 41 2.6 Parallel Resistors and Current Division 42 †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 Mesh Analysis with Current Sources 92 Chapter 3 Methods of Analysis 87 Review Questions 190 Chapter 5 Operational Amplifiers 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 174 5.6 Summing Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	† 2.3	Nodes, Branches, and Loops 33		
2.6 Parallel Resistors and Current Division †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis 87 3.4 Mesh Analysis 87 Mesh Analysis with Current Sources 92 S.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 176 5.6 Summing Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	2.4	Kirchhoff's Laws 35		Completionsive Floorenis 102
2.6 Parallel Resistors and Current Division †2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 Methods of Analysis with Current Sources 92 S.1 Introduction 166 5.2 Operational Amplifiers 166 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 176 5.6 Summing Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.10.1 Summary 188 Review Questions 190	2.5	Series Resistors and Voltage Division	41	Chapter 5 Operational Amplifiers 165
†2.7 Wye-Delta Transformations 50 †2.8 Applications 54 2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 \$2.8.1 Lighting Systems 5.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 176 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	2.6	Parallel Resistors and Current Division	42	
2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 S.3 Ideal Op Amp 170 5.4 Inverting Amplifier 171 5.5 Noninverting Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	† 2.7	Wye-Delta Transformations 50		
2.8.1 Lighting Systems 2.8.2 Design of DC Meters 2.9 Summary 60 5.6 Summing Amplifier 174 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 Review Questions 190	† 2.8	Applications 54		
2.8.2 Design of DC Meters 2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 S.5 Noninverting Amplifier 174 5.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190		2.8.1 Lighting Systems		
2.9 Summary 60 Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 S.6 Summing Amplifier 176 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190		2.8.2 Design of DC Meters		
Review Questions 61 Problems 63 Comprehensive Problems 72 Chapter 3 Methods of Analysis 75 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 Review Questions 15 5.7 Difference Amplifier 177 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	2.9	Summary 60		<u> </u>
Comprehensive Problems 72 5.8 Cascaded Op Amp Circuits 181 5.9 Op Amp Circuit Analysis with PSpice 183 †5.10 Applications 185 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 Review Questions 190	Review Ques	stions 61		C 1
5.9 Op Amp Circuit Analysis with PSpice 183 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 S.9 Op Amp Circuit Analysis with PSpice 183 5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190				
Chapter 3 Methods of Analysis 75 with PSpice 183 3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 Review Questions 190 with PSpice 183 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190	Comprehens	ive Problems 72		
3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 3.6 Review Questions 190 †5.10 Applications 185 5.10.1 Digital-to Analog Converter 5.10.2 Instrumentation Amplifiers 188 6.11 Summary 188 6.12 Review Questions 190	Ch	apter 3 Methods of Analysis 75		
3.1 Introduction 76 3.2 Nodal Analysis 76 3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 3.6 Review Questions 190		· · · · · · · · · · · · · · · · · · ·		
3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 Review Questions 190 5.10.2 Instrumentation Amplifiers 5.11 Summary 188 Review Questions 190				**
3.3 Nodal Analysis with Voltage Sources 82 3.4 Mesh Analysis 87 3.5 Mesh Analysis with Current Sources 92 Review Questions 190			00	
3.5 Mesh Analysis with Current Sources 92 Review Questions 190		•	82	_
		,	02	
†36 Nodal and Mesh Analyses by Inspection 95 Comprehensive Problems 200		-		Problems 191

xii CONTENTS

6.1 Introduction 202 6.2 Capacitors 202 6.3 Series and Parallel Capacitors 208 6.4 Inductors 211 6.5 Series and Parallel Inductors 216 6.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.3 Analog Computer 6.7 Summary 225 Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.4 Automobile Ignition Circuit 7.10 Summary 282	6.1 Introduction 202 6.2 Capacitors 202 6.3 Series and Parallel Capacitors 208 6.4 Inductors 211 6.5 Series and Parallel Inductors 216 76.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.4 Integrator 6.6.5 Analog Computer 6.6.5 Series and Parallel Inductors 216 7.1 Summary 225 Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 243 7.6 Step Response of an RC Circuit 263 7.7 First-Order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 350 Review Questions 340 Problems 311 Comprehensive Problems 350 Chapter 9 Sinusoids and Phasors 353 Number of Review Questions 355 9.1 Introduction 354 9.2 Sinusoids 355 9.3 Phasors 359 9.4 Phasors Relationships for Circuit Elements 367 9.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 19.8 Applications 379 9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoids and Phasors 353 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 394 10.4 Superposition Theorem 400 10.7 Op Amp AC Circuits 411 10.4 AC Analysis Using PSpice 413 10.9 Applications 416 10.9 Capacitance Multiplier 10.9.2 Oscillators	Chi	apter 6 Capacitors and Inductors 201	8.12 Summary 340
6.2 Capacitors 202 6.3 Series and Parallel Capacitors 208 6.4 Inductors 211 6.5 Series and Parallel Inductors 216 6.6.2 Differentiator 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.1 Integrator 6.6.3 Analog Computer 6.7 Summary 225 6.8 Problems 227 Comprehensive Problems 225 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.3 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RC Circuit 268 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 10.3 Mesh Analysis 394 7.10 Summary 282 Comprehensive Problems 350 PART 2 AC CIRCUITS 351 Chapter 9 Sinusoids and Phasors 353 9.1 Introduction 354 9.2 Sinusoids 355 9.3 Phasor Relationships for Circuit Elements 367 9.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 19.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 4004	6.2 Capacitors 202 6.3 Series and Parallel Capacitors 208 6.4 Inductors 211 6.5 Series and Parallel Inductors 216 6.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.4 Integrator 6.6.3 Analog Computer 6.6.5 Summary 225 6.7 Summary 225 Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 284 Comprehensive Problems 293 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 411 10.6 AC Analysis Using PSpice 413 10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			
6.3 Series and Parallel Capacitors 208 6.4 Inductors 211 6.5 Series and Parallel Inductors 216 **6.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 9.2 Sinusoids 355 6.6.3 Analog Computer 9.2 Sinusoids 355 9.3 Phasors 359 Review Questions 226 9.4 Phasor Relationships for Circuit Elements 367 Problems 235 9.5 Impedance and Admittance 369 Chapter 7 First-Order Circuits 237 9.7 Impedance Combinations 373 T.1 Introduction 238 19.8 Applications 379 7.1 Introduction 238 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.2 Problems 9.8.2 AC Bridges 9.9 Summary 384 7.1 First-order Op Amp Circuits 263 Problems 385 7.9 Applications 276 273 Chapter 10 Sinusoidal Steady-State Analysis 393 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 10.1	6.3 Series and Parallel Capacitors 208 6.4 Inductors 211 6.5 Series and Parallel Inductors 216 76.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 6.7 Summary 225 6.7 Summary 225 6.8 Review Questions 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7.1 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoliable Unit 7.9.3 Relay Circuits 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.5 Seriew Questions 284 Comprehensive Problems 293 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-free Series RLC Circuit 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301			
6.4 Inductors 211 6.5 Series and Parallel Inductors 216 6.6. Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.2 Differentiator 9.1 Introduction 354 6.6.3 Analog Computer 9.2 Sinusoids 355 8.7 Summary 225 9.4 Phasor Relationships for Circuit Review Questions 226 9.4 Phasor Relationships for Circuit Comprehensive Problems 235 9.5 Impedance and Admittance 369 Comprehensive Problems 235 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 7.1 Introduction 238 9.8.1 Phase-Shifters 9.8.2 AC Bridges 7.3 The Source-free RC Circuit 243 9.8.2 AC Bridges 7.4 Singularity Functions 249 9.9 Summary 385 7.5 Step Response of an RL Circuit 268 7.7.9 First-order Op Amp Circuit 268 7.8 Transient Analysis with PSpice 273 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relationships for Circuit 885 7comprehensive Problems 385 </th <td> Chapter 8 Second-Order Circuits 216 </td> <td></td> <td>1</td> <td>•</td>	Chapter 8 Second-Order Circuits 216		1	•
6.5 Series and Parallel Inductors 216 76.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.4 Note that the problems 225 Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.3 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9.1 Delay Circuits 276 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 103 Mesh Analysis 394 7.10 Summary 282	Chapter 8 Series and Parallel Inductors 216		-	DART 2 AC CIRCUITC 251
76.6 Applications 219 6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 7.5 Summary 225 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RL Circuit 263 7.7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9 Delay Circuits 276 7.9.1 Delay Circuits 276 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 10.3 Mesh Analysis 397 7.10 Summary 282 Chapter 9 Sinusoids and Phasors 353 9.1 Introduction 354 9.2 Sinusoids 355 9.3 Phasors 359 9.4 Phasor Relationships for Circuit Elements 367 9.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 19.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8 Summary 384 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 397 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	Chapter 8 Second-Order Circuits 295			
6.6.1 Integrator 6.6.2 Differentiator 6.6.3 Analog Computer 6.6.3 Analog Computer 6.6.4 Summary 6.6.5 Summary 6.6.5 Summary 6.6.5 Summary 6.6.6 Summary 6.6.6 Summary 6.6.6 Summary 6.6.6 Summary 6.6.7 Summary 6.6.8 Summary 6.6.8 Summary 6.6.9 Phasors 6.7 Summary 6.6.9 Phasors 6.7 Summary 6.6.1 Introduction 6.6.2 Differentiator 6.6.2 Differentiator 6.6.3 Analog Computer 9.1 Introduction 9.2 Sinusoids 9.5 Phasors 9.6 Phasor Relationships for Circuit 6.6.2 Elements 9.7 Impedance and Admittance 9.8 Summary 9.8 Impedance and Admittance 9.9 Summary 9.9 Summary 9.8 Applications 9.8 Applications 9.9 Summary 9.8 Applications 9.8 Appli	Service Questions 226 Sinusoids 355			Chapter 9 Sinusoids and Phasors 353
6.6.2 Differentiator 6.6.3 Analog Computer 9.2 Sinusoids 355 6.6.3 Phasors 359 9.4 Phasor Relationships for Circuit Elements 367 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 9.2 Sinusoids 355 9.3 Phasors 359 9.4 Phasor Relationships for Circuit Elements 367 Fingle dance and Admittance 369 9.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Froblems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	Solution			9.1 Introduction 354
6.6.3 Analog Computer 6.6.3 Analog Computer 6.7 Summary 225 Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 9.3 Phasors 359 9.4 Phasor Relationships for Circuit Elements 367 9.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	Second-Order Circuits Part			
6.7 Summary 225 Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 †7.7 First-order Op Amp Circuits 268 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 10.1 Summary 282 9.4 Phasor Relationships for Circuit Elements 367 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.2 AC Bridges 9.9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	Summary 225 9.4 Phasor Relationships for Circuit Elements 367			
Review Questions 226 Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 Elements 367 9.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 1.1 Introduction 238 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	Review Questions 226 226 367 226 369 227 238 372 238 373 373 374 238 374 375	6.7		
Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 1.5 Impedance and Admittance 369 9.6 Kirchhoff's Laws in the Frequency Domain 372 9.7 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	Problems 227 Comprehensive Problems 235 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 10.3 Mesh Analysis 397 7.10 Summary 282 Review Questions 283 Review Questions 283 Review Questions 283 7.10 Summary 282 Review Questions 283 7.11 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 Review Questions 296 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301		-	1
Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 †7.7 First-order Op Amp Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 7.1 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	Chapter 7 First-Order Circuits 237 Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RC Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.7.1 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Delay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Review Questions 283 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 Review Questions 394 Review Questions 395 Chapter 10 Sinusoidal Steady-State Analysis 394 Introduction 394 Introduc			
Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Domain 372 9.7 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	Chapter 7 First-Order Circuits 237 7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.2 Photoflash Unit 7.9.4 Automobile Ignition Circuit 10.3 Mesh Analysis 397 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 Domain 372 9.7 Impedance Combinations 373 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9 Applications 379 10.1 Introduction 394 10.2 Nodal Analysis 394 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416	Comprehensi	ive Problems 235	•
7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 †9.8 Applications 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 7.1 Introduction 238 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.9 Summary 384 Review Questions 385 Comprehensive Problems 385 Comprehensive Problems 392 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 10.3 Mesh Analysis 394 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			
7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 7.11 Introduction 379 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.1 Phase-Shifters 9.8.2 AC Bridges 9.8.1 Phase-Shifters 9.8.2 AC Bridges 10.1 Introduction 385 Comprehensive Problems 392 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 394 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	7.1 Introduction 238 7.2 The Source-free RC Circuit 238 7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 263 7.6 Step Response of an RL Circuit 263 7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators	Ch	apter 7 First-Order Circuits 237	9.7 Impedance Combinations 373
7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 7.10 Summary 282 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8.2 AC Bridges 10.1 Introduction 385 Comprehensive Problems 392 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 394 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 7.10 Summary 282 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301	7.1	Introduction 238	-
7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 7.10 Summary 282 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8.2 AC Bridges 9.8.2 AC Bridges 10.1 Introduction 385 Comprehensive Problems 392 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 394 10.4 Superposition Theorem 400 10.5 Source Transformation 4044	7.3 The Source-free RL Circuit 243 7.4 Singularity Functions 249 7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 7.10 Summary 282 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301	7.2	The Source-free <i>RC</i> Circuit 238	9.8.1 Phase-Shifters
7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301		The Source-free <i>RL</i> Circuit 243	
7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.5 Step Response of an RC Circuit 257 7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301	7.4		99 Summary 384
7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 7.6 Step Response of an RL Circuit 263 Problems 385 Comprehensive Problems 392 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.6 Step Response of an RL Circuit 263 †7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators		•	
†7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.9.1 Summary 282 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.7.7 First-order Op Amp Circuits 268 7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 **Chapter 10 Sinusoidal Steady-State Analysis 393 **Chapter 10 Sinusoidal Steady-State Analysis 393 **Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †**10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			
7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.8 Transient Analysis with PSpice 273 †7.9 Applications 276 Chapter 10 Sinusoidal Steady-State Analysis 393 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 10 Sinusoidal Steady-State Analysis 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301			Comprehensive Problems 392
 †7.9 Applications 276 Chapter 10 Sinusoidal Steady-State Analysis 393 7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 	7.9.1 Delay Circuits 7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 Chapter 10 Sinusoidal Steady-State Analysis 393 10.1 Introduction 394 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			
7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			Chapter 10 Sinusoidal Steady-State Analysis 393
7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.9.2 Photoflash Unit 7.9.3 Relay Circuits 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.2 Nodal Analysis 394 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators		7.9.1 Delay Circuits	IO.1 Introduction 394
7.9.4 Automobile Ignition Circuit 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 10.3 Mesh Analysis 397 10.4 Superposition Theorem 400 10.5 Source Transformation 404	7.9.4 Automobile Ignition Circuit 7.9.4 Automobile Ignition Circuit 7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 Resh Analysis 397 10.4 Superposition Theorem 400 Superposition Theorem 400 Superposition Theorem 400 Chapter 8 Superposition Theorem 400 Sup			
7.10 Summary 282 10.4 Superposition Theorem 400	7.10 Summary 282 Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.4 Superposition Theorem 400 10.5 Source Transformation 404 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			· · · · · · · · · · · · · · · · · · ·
7.10 Summary 282 10.5 Source Transformation 404	Review Questions 283 Problems 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.5 Source Transformation 404 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators	7.10	•	•
	Problems 284 Comprehensive Problems 293 Chapter 8 Second-Order Circuits 295 8.1 Introduction 296 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.6 Thevenin and Norton Equivalent Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators		-	1 1
106 They on in and Mentan Equivalent	Comprehensive Problems 293 Circuits 406 10.7 Op Amp AC Circuits 411 10.8 AC Analysis Using PSpice 413 10.9 Applications 416			10.6 Thevenin and Norton Equivalent
-	Chapter 8 Second-Order Circuits 295 IO.8 AC Analysis Using PSpice 413 8.1 Introduction 296 †10.9 Applications 416 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.8 AC Analysis Using PSpice 413 †10.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators			
10.7 Op Amp AC Circuits 411	Chapter 8 Second-Order Circuits 295 IO.8 AC Analysis Using PSpice 413 8.1 Introduction 296 †IO.9 Applications 416 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series RLC Circuit 301 10.8 AC Analysis Using PSpice 413 †IO.9 Applications 416 10.9.1 Capacitance Multiplier 10.9.2 Oscillators		<u></u>	10.7 Op Amp AC Circuits 411
	8.1 Introduction 296 †10.9 Applications 416 8.2 Finding Initial and Final Values 296 10.9.1 Capacitance Multiplier 10.9.2 Oscillators	Ch	apter 8 Second-Order Circuits 295	
†100 Applications 416	 8.2 Finding Initial and Final Values 296 8.3 The Source-Free Series <i>RLC</i> Circuit 301 10.9.1 Capacitance Multiplier 10.9.2 Oscillators 	Q I	Introduction 206	
0.1 introduction 290	8.3 The Source-Free Series <i>RLC</i> Circuit 301			
10.0.2 Oscillators				
8.4 The Source-Free Parallel <i>RLC</i> Circuit 308 10.10 Summary 420	84 The Source-Free Parallel RIC Circuit 308 In In Summary 420			10.10 Summary 420
111 Source-free Farance RZC Circuit 500 Summary 420	Vit The Source-Tree Laranci Mee Cheun 500 1919 Summary 420			•
85 Step Response of a Series RLC Review Questions 421		0.3		Problems 422
8.5 Step Response of a Series <i>RLC</i> Review Questions 421 Problems 422	8.5 Step Response of a Series <i>RLC</i> Review Questions 421 Problems 422	9.4		
Circuit 314 Problems 422	8.5 Step Response of a Series <i>RLC</i> Circuit 314 Review Questions 421 Problems 422	0.0	• •	Chapter 11 AC Power Analysis 433
Circuit 314 8.6 Step Response of a Parallel RLC Chapter II AC Power Analysis 433	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Chapter II AC Power Analysis 433	0 7		
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 Problems 422 Chapter II AC Power Analysis 433	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 Review Questions 421 Problems 422 Chapter II AC Power Analysis 433			
Circuit 314 8.6 Step Response of a Parallel <i>RLC</i> Circuit 319 8.7 General Second-Order Circuits 322 Problems 422 Chapter II AC Power Analysis 433	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 Review Questions 421 Problems 422 Chapter II AC Power Analysis 433		1 1	
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 Problems 422 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 43:	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 434			_
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 Problems 422 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 43. II.3 Maximum Average Power Transfer 4.	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 Review Questions 421 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 434 II.3 Maximum Average Power Transfer 440		<u> </u>	
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 11.1 Introduction 434 11.2 Instantaneous and Average Power 43 11.3 Maximum Average Power Transfer 4 11.4 Effective or RMS Value 443	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 11.1 Introduction 434 11.2 Instantaneous and Average Power 434 11.3 Maximum Average Power Transfer 440 11.4 Effective or RMS Value 443	10.11	Applications 330	**
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 †8.10 Duality 332 †8.11 Applications 336 Problems 422 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 43. II.3 Maximum Average Power Transfer 4 II.4 Effective or RMS Value 443 II.5 Apparent Power and Power Factor 44.	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 †8.10 Duality 332 †8.11 Applications 336 Review Questions 421 Chapter II AC Power Analysis 433 II.1 Introduction 434 III.2 Instantaneous and Average Power 434 III.3 Maximum Average Power Transfer 440 III.4 Effective or RMS Value 443 III.5 Apparent Power and Power Factor 447		8.11.1 Automobile Ignition System	•
		8.5	Step Response of a Series RLC	Review Questions 421
Of Chan Danger of Carine DLC Paying Questions 421		0.3		·
Problems 422	8.5 Step Response of a Series <i>RLC</i> Review Questions 421 Problems 422			1100101110
Circuit 314 Problems 422	8.5 Step Response of a Series <i>RLC</i> Circuit 314 Review Questions 421 Problems 422	8.6	Step Response of a Parallel <i>RLC</i>	Chapter II AC Power Analysis 433
Circuit 314 8.6 Step Response of a Parallel RLC Chapter II AC Power Analysis 433	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Chapter II AC Power Analysis 433			
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 Problems 422 Chapter II AC Power Analysis 433	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 Review Questions 421 Problems 422 Chapter II AC Power Analysis 433			
Circuit 314 8.6 Step Response of a Parallel <i>RLC</i> Circuit 319 8.7 General Second-Order Circuits 322 Problems 422 Chapter II AC Power Analysis 433	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 Review Questions 421 Problems 422 Chapter II AC Power Analysis 433		1 1	
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 Problems 422 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 43:	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 434			_
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 Problems 422 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 43. II.3 Maximum Average Power Transfer 4.	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 Review Questions 421 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 434 II.3 Maximum Average Power Transfer 440		<u> </u>	
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 11.1 Introduction 434 11.2 Instantaneous and Average Power 43 11.3 Maximum Average Power Transfer 4 11.4 Effective or RMS Value 443	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 11.1 Introduction 434 11.2 Instantaneous and Average Power 434 11.3 Maximum Average Power Transfer 440 11.4 Effective or RMS Value 443	†8.11	Applications 336	II.5 Apparent Power and Power Factor 447
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 11.1 Introduction 434 11.2 Instantaneous and Average Power Transfer 4 11.3 Maximum Average Power Transfer 4 11.4 Effective or RMS Value 443 11.5 Apparent Power and Power Factor 44	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 11.1 Introduction 434 11.2 Instantaneous and Average Power 434 11.3 Maximum Average Power Transfer 440 11.4 Effective or RMS Value 443 11.5 Apparent Power and Power Factor 447		8 11 1 Automobile Ignition System	II.6 Complex Power 449
Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 †8.10 Duality 332 †8.11 Applications 336 Problems 422 Chapter II AC Power Analysis 433 II.1 Introduction 434 II.2 Instantaneous and Average Power 43. II.3 Maximum Average Power Transfer 4 II.4 Effective or RMS Value 443 II.5 Apparent Power and Power Factor 44.	8.5 Step Response of a Series RLC Circuit 314 8.6 Step Response of a Parallel RLC Circuit 319 8.7 General Second-Order Circuits 322 8.8 Second-Order Op Amp Circuits 327 8.9 PSpice Analysis of RLC Circuits 330 †8.10 Duality 332 †8.11 Applications 336 Review Questions 421 Chapter II AC Power Analysis 433 II.1 Introduction 434 III.2 Instantaneous and Average Power 434 III.3 Maximum Average Power Transfer 440 III.4 Effective or RMS Value 443 III.5 Apparent Power and Power Factor 447		8 11 2 Smoothing Circuits	†11.7 Conservation of AC Power 453

CONTENTS

11.8	Power Factor Correction 457	14.4 Bode Plots 589
†11 .9	Applications 459	14.5 Series Resonance 600
	11.9.1 Power Measurement	14.6 Parallel Resonance 605
	11.9.2 Electricity Consumption Cost	14.7 Passive Filters 608
11.10	Summary 464	14.7.1 Lowpass Filter 14.7.2 Highpass Filter
Review Questi Problems	ions 465 466	14.7.2 Highpass Filter 14.7.3 Bandpass Filter
Comprehensiv		14.7.4 Bandstop Filter
Char	oter 12 Three-Phase Circuits 477	14.8 Active Filters 613
12.1	Introduction 478	14.8.1 First-Order Lowpass Filter 14.8.2 First-Order Highpass Filter
12.1	Balanced Three-Phase Voltages 479	14.8.3 Bandpass Filter
12.2	Balanced Wye-Wye Connection 482	14.8.4 Bandreject (or Notch) Filter
12.3	Balanced Wye-Wye Connection 486	† 14.9 Scaling 619
12.5	Balanced Delta-Delta Connection 488	14.9.1 Magnitude Scaling
12.6	Balanced Delta-Wye Connection 490	14.9.2 Frequency Scaling
12.7	Power in a Balanced System 494	14.9.3 Magnitude and Frequency Scaling
†12.8	Unbalanced Three-Phase Systems 500	14.10 Frequency Response Using
12.9	PSpice for Three-Phase Circuits 504	PSpice 622
†12.10	Applications 508	† I4.II Applications 626
	12.10.1 Three-Phase Power Measurement	14.11.1 Radio Receiver
	12.10.2 Residential Wiring	14.11.2 Touch-Tone Telephone 14.11.3 Crossover Network
12.11	Summary 516	14.12 Summary 631
Review Questi		Review Questions 633
Problems Comprehensiv	518 e Problems 525	Problems 633
Comprehensiv	C 1 1001Cms 323	Comprehensive Problems 640
Chap	oter 13 Magnetically Coupled Circuits 527	
13.1	Introduction 528	PART 3 ADVANCED CIRCUIT ANALYSIS 643
13.2	Mutual Inductance 528	
13.3	Energy in a Coupled Circuit 535	Chapter 15 The Laplace Transform 645
13.4	Linear Transformers 539	I5.1 Introduction 646
13.5	Ideal Transformers 545	15.2 Definition of the Laplace
13.6	Ideal Autotransformers 552	Transform 646
†13.7	Three-Phase Transformers 556	15.3 Properties of the Laplace
13.8	PSpice Analysis of Magnetically Coupled	Transform 649
	Circuits 559	15.4 The Inverse Laplace Transform 659
†13.9	Applications 563	15.4.1 Simple Poles
	13.9.1 Transformer as an Isolation Device	15.4.2 Repeated Poles
	13.9.2 Transformer as a Matching Device	15.4.3 Complex Poles
	13.9.3 Power Distribution	15.5 Application to Circuits 666
13.10	Summary 569	15.6 Transfer Functions 672
Review Questi		15.7 The Convolution Integral 677
Problems Comprehensiv	571 e Problems 582	† 15.8 Application to Integrodifferential
Comprehensiv	e i roments 302	Equations 685
Chap	oter 14 Frequency Response 583	† 15.9 Applications 687
14.1	Introduction 584	15.9.1 Network Stability
14.2		15.9.2 Network Synthesis
17.4	Transfer Function 584	•

xiv CONTENTS

Review Quest Problems	696	17.8 Summary 789 Review Questions 790
Comprehensiv	ve Problems 705	Problems 790 Comprehensive Problems 794
Cha	pter 16 The Fourier Series 707	Completiensive Problems 794
16.1	Introduction 708	Chapter 18 Two-Port Networks 795
16.2	Trigonometric Fourier Series 708	18.1 Introduction 796
16.3	Symmetry Considerations 717	18.2 Impedance Parameters 796
	16.3.1 Even Symmetry	18.3 Admittance Parameters 801
	16.3.2 Odd Symmetry	18.4 Hybrid Parameters 804
	16.3.3 Half-Wave Symmetry	18.5 Transmission Parameters 809
16.4	Circuit Applicatons 727	† 18.6 Relationships between Parameters 814
16.5	Average Power and RMS Values 730	18.7 Interconnection of Networks 817
16.6	Exponential Fourier Series 734	18.8 Computing Two-Port Parameters Using
16.7	Fourier Analysis with <i>PSpice</i> 740	PSpice 823
	16.7.1 Discrete Fourier Transform	† 18.9 Applications 826
	16.7.2 Fast Fourier Transform	18.9.1 Transistor Circuits
†16.8	Applications 746	18.9.2 Ladder Network Synthesis
	16.8.1 Spectrum Analyzers	18.10 Summary 833
	16.8.2 Filters	Review Questions 834 Problems 835
16.9	Summary 749	Comprehensive Problems 844
Review Quest		
Problems Comprehensiv	751 ve Problems 758	Appendix A Solution of Simultaneous Equations Using Cramer's Rule 845
Chap	oter 17 Fourier Transform 759	Appendix B Complex Numbers 851
17.1	Introduction 760	Appendix C Mathematical Formulas 859
17.2	Definition of the Fourier Transform 760	Appendix D PSpice for Windows 865
17.3	Properties of the Fourier Transform 766	
17.4	Circuit Applications 779	Appendix E Answers to Odd-Numbered Problems 893
17.5	Parseval's Theorem 782	Selected Bibliography 929
17.6	Comparing the Fourier and Laplace Transforms 784	Index 933
†1 7.7	Applications 785	
	17.7.1 Amplitude Modulation 17.7.2 Sampling	